To what extent can partial retirement ensure retirement income adequacy?

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Abstract

We analyze the implications of partial retirement for the financial well-being of older individuals, and to what extent this implies a self-reliant financial security in retirement. Using data on the pension entitlements of the clients of a large pension fund, we show that, on average, when individuals retire partially before the legal retirement age, they attain at least a minimum target replacement rate of 70 percent during partial retirement, and subsequently a higher replacement rate during full retirement. Individuals with fewer numbers of years of pension accrual and those living with a partner have a much higher risk of falling below the minimum target replacement rate. The risk is reduced by a large amount if individuals retire part-time instead of full-time.

1 Introduction

Recent policy measures in the Netherlands aim at tailoring the individual retirement income to personal financial needs and making the pension system financially sustainable. Workers bear increasing investment risk through the indexation of their pension rights with respect to the returns on investment in the financial market. The accrual rate of the occupational pension rights is also planned to be reduced. This will make individuals more dependent on alternative sources of income during retirement, or induce them to work longer to compensate for lost income due to reductions in accrued or paid pension rights. Furthermore, the pension law is expected to accelerate the shift from defined benefit to defined contribution pension schemes. Compared to a defined benefit scheme, in a defined contribution scheme the worker has to bear higher risks and face greater responsibility to secure an adequate level of retirement income through decisions on contribution rates, asset allocation, or decumulation strategy, which all require an adequate level of financial literacy (Poterba, 2014).

Partial retirement can help individuals to secure their financial well-being in retirement. For example, by working part-time at an otherwise early retirement age, individuals can rely on part-time labour earnings instead of only on an actuarially penalized occupational pension (Laczko, 1988; Kantarcı et al., 2013). While working part-time, individuals also continue to accrue pension rights for full retirement at a later age. Partial retirement can also be beneficial for public finances if it extends working lives. In fact, several studies have suggested that supplementing the retirement income with income from part-time work can ease the pressure on the pension system caused by the population aging in the United States and in Europe (Laczko, 1988; Chen, 1996; Cahill et al., 2006; Robinson and Clark, 2010). This is in line with the policy objective of the European Commission that focuses on ensuring the adequacy of

pensions in aging societies without putting public finances under strain (European Commission, 2012).

Van Duijn et al. (2013) and Knoef et al. (2016) investigate retirement income adequacy based on replacement rates when individuals retire full-time from their career job before or at the legal retirement age. Kantarcı et al. (2013) compute replacement rates in full and partial retirement scenarios for a hypothetical worker with given job characteristics. These studies provide rich analyses on financial security in retirement as they compare the actual with expected replacement rates, study the implications of partial retirement for replacement rates, or identify the vulnerable groups in the population that have replacement rates below a minimum target level or full replacement level. However, in these studies the calculation of the replacement rate is not based on the actual wages and pension rights at the time of retirement, but on the projections of wages and pension rights from the time of observation until the day of retirement based on strong assumptions about wage profiles, work histories, and accumulation of pension rights.

We analyze the retirement income of the clients of a large pension fund in relation to their pre-retirement earnings to investigate their financial well-being in retirement. As information on the accrued pension rights up to the retirement age is available, we make weak assumptions when analyzing pension income adequacy. We start by analyzing cases of full retirement where pension plan participants stop working and claim full occupational pension rights at ages from 60 to 70. We then analyze cases where individuals partially retire and claim a fraction of their accrued pension rights at the same ages. We take account of the receipt of state pension rights and the income tax rules and tax credits. Our main aim is to show, among the clients of a large pension fund, to what extent retiring part-time instead of full-time reduces the risk of falling below a minimum target replacement rate of 70 percent both before and after the legal retirement age.

We show that both before and after the legal retirement age workers attain a much higher level of retirement income security when they retire part-time and combine part-time earnings with a partial pension, compared to when they retire full-time and claim the full amount of their accrued pension rights. For example, if the sample of workers retire full-time at age 63, about 22 percent fall below the minimum target replacement rate at age 70, while if they retire part-time at the same age for a period of five years, about 4 percent fall below the minimum target replacement rate at age 70. Furthermore, we show that when individuals retire part-time instead of full-time at a given age, they are much less prone to income shocks due to, for example, zero indexation of occupational pension rights, or a smaller occupational pension income for having accumulated pension rights for fewer years.

The remainder of this paper is organized as follows. Section 2 describes the institutional setting. Section 3 describes the data. Section 4 describes the assumptions and calculation of the replacement rates. Section 5 presents the results. Section 6 discusses policy implications and concludes.

2 The Dutch pension and income tax systems

The retirement income stands on three pillars in the Netherlands. The first pillar is the state pension, the second pillar is the occupational pension, and the third pillar is the individual savings. All retirees who never lived abroad receive the full state pension, and the majority of them participate in a mandatory occupational pension scheme that is of the defined benefit type. The share of the third pillar in retirement income is much smaller and its importance varies

much more across individuals (Alessie and Kapteyn, 2001; Knoef et al., 2016).[1] Therefore, the role of the third pillar is not considered in this study. This fairly homogeneous pension system allows a systematic analysis of the retirement income across a large population of retirees with otherwise heterogeneous characteristics.

The state pension scheme

The General Old-Age Pensions Act (AOW) is the state pension scheme, paying flat-rate benefits to people above the statutory retirement age who have always lived in the Netherlands, independent of earnings, income or premiums paid (Sociale Verzekeringsbank, 2019).[2] It provides households with a subsistence level income in which the breadwinner attainted the eligibility age or is older. The only thing that therefore matters for the benefit level is household composition: individuals in couples each receive less than people living alone and there are special allowances for children younger than 21 and one earner couples in which only the breadwinner is age eligible.

The scheme is unfunded and based on the pay-as-you-go principle so that current pensions are financed from the current premiums paid by workers. The premiums are paid as a percentage of work income through the income tax, and labeled as national insurance premiums. Everybody who lives in the Netherlands is insured under the scheme. The maximum period of insurance is 50 years, from the age of 15 until the statutory retirement age. For those who do not live in the Netherlands all this time, the benefit is adjusted proportionally.

The state pension is paid as an annuity after the statutory retirement age, and calculated as the sum of the product of the accrual rate and pension base from each year over the period of insurance. The accrual rate is 2 percent per year. The pension base is determined by the government according to the net minimum wage. It depends on the domestic situation of the retiree: single without a child, single with a child under 18 years old, living with a partner who is older than 65 years old, living with a partner who is younger than 65 years old with or without supplementary allowance.

In the state pension scheme, it is not possible to claim part or the full amount of the accrued pension rights before or after the legal retirement age. However, the government has put forward proposals to introduce flexible retirement options into the state pension scheme in 2008 and recently in 2019 (Ministerie van Sociale Zaken en Werkgelegenheid, 2008, 2019). The proposal put forward in 2008, in particular, presented a detailed pension scheme including the actuarial rules for deferring pension rights to a later retirement age. In this study we will assume that this pension scheme is in operation and that in hypothetical retirement scenarios individuals who work beyond age 65 defer part or the full amount of their state pension rights until retirement to smooth their total income. The scheme allows an employee to defer part or all of his state pension rights for a maximum of five years. It is not possible to accrue additional rights during the deferral period. Deferred rights are actuarially increased at the time of claim. The increase is calculated as the product of the deferred pension rights at the statutory retirement age and an actuarial factor specific to the age the pension rights are eventually claimed. The top panel of Table 2 shows the year-specific actuarial factors for possible ages of claiming state pension rights. The factor is calculated by dividing the life expectancy at age 65 by the life expectancy at age 65 that is reduced by the number of years of delay. The life expectancy at age 65 is the average of the life expectancies of men and women at age 65. For example, the factor for

[1] Knoef et al. (2016) show that, in 2010, among people who are 60 to 64 years old, the median net replacement rate is 82 percent when public and occupational pension benefits are considered in the calculation, and it increases to 92 percent when, in addition, voluntary third pillar pensions but also private wealth are taken into account.

[2] The statutory retirement age is 66 in 2018, and is being gradually increased to reach 67 in 2021. It will be linked to life expectancy from 2022.

claiming pension rights at age age 70 is 1.354. It is calculated using the life expectancy at age 65 in 2017 which is equal to 19.14 years according to Statistics Netherlands, and five years of delay due to deferral of the pension rights from age 65 until age 70.

An occupational pension scheme

In the Netherlands, employees are obliged to participate in an occupational old-age pension scheme. In most cases the scheme is of the defined benefit type. It is funded so that pensions are financed from the premiums of the participants paid in the past and from the returns on the invested premiums. It is an individual scheme, but for employees with a partner, it incorporates a widow's pension, and orphan's pension for children up to an age threshold. We do not incorporate the widow's and orphan's pensions in our calculations of pension benefits since they would involve another layer of complexity. Furthermore, in case of a divorce, the other spouse can be entitled to part of the accumulated pension. This is not taken into account in our calculations. We base our analysis on the defined benefit scheme of the Pensioenfonds Zorg en Welzijn (PFZW), the second largest pension fund in the Netherlands.

Employees pay premiums into their pension plan which is calculated as the product of the full-time equivalent, contribution rate, and the premium base. The contribution rate is shared by the employee and the employer. Premium base is given by the difference between the gross labor income and the state pension offset. Employees do not accrue pension over the state pension offset since they also pay premiums for state pensions. Table 1 shows the state pension offset amounts for the years from 2007 to 2013.

The occupational pension is paid as an annuity after the statutory retirement age. It is calculated as the sum of the pension rights accrued in each year over the period employees accrue pension rights. In a given year, accrued rights is calculated as the product of the full-time equivalent, the accrual rate, and the premium base. Accrual rate is the rate at which the pension rights build up. Table 1 shows the accrual rates for the years from 2007 to 2013.

The scheme is an average salary scheme, with each year's salary contributing in the same way. Two specific issues regarding the calculation of the pension annuity need to be mentioned. First, the pension annuity depends on the domestic situation. If the participant is not single when he first claims his pension rights, the pension annuity applies and the participant's spouse is entitled to a survivor pension when the participant dies. If the participant is single when first claiming, the pension annuity is increased by a certain fraction. Second, pension funds aim to increase the pension annuities each year in accordance with wage inflation in the sectors they are operating. The actual increase can be the same, lower, or higher than the increase in the average wage, depending on the financial situation of the pension fund ('conditional indexation'). In our analysis we assume no increase in wages and no indexation. Our analysis can therefore be interpreted as an analysis of real wages under the assumption of full indexation and equality of wage and price inflation.

Claiming the pension annuity earlier or later than the statutory retirement age has implications for the amount of the pension annuity paid. Deferring the claim of the pension annuity at the statutory retirement age affects the eventual amount of the pension annuity when it is claimed in two respects. First, the annuity deferred at the statutory retirement age will increase due to the actuarial adjustment at the age the annuity is claimed. The increase is calculated as the product of the pension annuity at the statutory retirement age and an actuarial factor specific to the age when the annuity is claimed. The actuarial factor depends on mortality rates and an interest rate. The actuarial factors used for retirement after the statutory retirement age are larger than 1 so that the deferred pension is increased. Second, the pension annuity at the age it is claimed will increase due to the additional rights accrued from the statutory

retirement age until the age the rights are claimed, and due to the actuarial adjustment of these rights at the age these rights are claimed.

Claiming the pension annuity earlier than the statutory retirement age affects the pension annuity as follows. First, since pension rights are accumulated until the early retirement age, the pension annuity will be smaller than that if pension rights were accumulated until the statutory retirement age. Second, the pension annuity at the early retirement age will fall due to actuarial adjustment at this age. The actuarial adjustment factors for early retirement are smaller than 1 so that early retirement is penalized. Table 2 shows the full set of year-specific actuarial factors for all retirement ages.

Note that the actuarial increase due to deferral of pension rights beyond age 65 is lower in the state pension scheme than in the occupational pension scheme since the actuarial factors in the state pension scheme are lower. This is due to the fact that the actuarial factors of the state pension scheme are driven by mortality rates only, whereas those of the occupational pension scheme are driven by mortality rates as well as by returns on invested pension premiums. It seems difficult for the government to increase the actuarial factors to the level of those of the occupational pension fund because the state pension system is unfunded meaning that the government cannot generate returns on the premiums.

The tax system

Every person who lives in the Netherlands and has some source of income is subject to the income tax. The income tax is an individual system, with some specific allowances that depend on household composition and income of other household members. Besides, every person has to buy basic health insurance from a private insurer at an income independent premium. An income dependent subsidy or tax compensates low income groups for the regulated income-independent premium of the basic health insurance, and this is integrated with income tax and national insurance premiums. Details of the calculation of the income after tax and health insurance premium payments are provided in the Appendix.

3 Data

We use administrative data from the PFZW that offers occupational pension plans for people working in the health care sector. Data is available for clients who accrue or claim pension rights during the period of observation from January 2007 to December 2014. The clients are cohorts of individuals aged 55 years or older at any given year of the observation period. The data includes information on age, gender, marital status, the number of years of pension accrual, accrued pension rights, claimed pension rights, full-time equivalent, and wage income during the period pension rights are accrued.

The initial sample consists of 1,657,978 individuals where for each individual multiple observations are available across the months of the years data is available for the individual. We impose a number of restrictions on the initial sample. First, in the data, individuals who retire before the legal retirement age often make use of an early retirement scheme that offers generous pension provisions. In the Netherlands early retirement schemes (VUT) have been phased out in the last two decades. Therefore, individuals who participate in an early retirement scheme are not considered in this study. This restriction leads to a sample of 1,540,774 individuals. Second, we require that individuals work full-time in their last job and subsequently retire full-time. This restriction leads to a sample of 8,666 individuals. The large decrease in the number of individuals is due to the fact that many clients of the pension fund have not yet reached the retirement age and for them retirement is not (yet) relevant. Third, we require that

individuals work full-time during the large part of their career before they retire part-time or full-time. Therefore, we restrict our analysis to individuals who have accrued pension rights on full-time pensionable salary for at least 35 years by the time they turn 65. We require fewer years of pension accrual for younger workers or for those who retire earlier than at age 65. This restriction leads to a sample of 3,313 individuals who constitute the baseline study sample.

We do not use individual data for the state pension income but assume that all individuals receive the universal flat-rate amount. This means that we also assume that all individuals are insured with the maximum period of insurance and receive the full amount of the state pension. The state pension income amounts we consider are those effective in the observation year when individuals become entitled to the state pension.

Table 3 presents descriptive statistics for a number of background and labor market characteristics. The majority of the sample is above age 60 and married or living with a partner. About 65 percent of the sample is men. Nearly half of the sample earns a gross annual wage close to the average of €47,422 in 2018 (**?**). A similar fraction earns a higher wage. Among the individuals who have accrued pension rights for at least 25 years, about half of them have accrued pension rights for at least 35 years. The reason for the high fractions of older individuals, men, and high-income earners in the sample is that the sample is selected to consist of individuals with at least 25 years of pension accrual on full-time pensionable salary whereas women often work part-time and earn lower wages and do not accrue, or accrue for fewer years, pension rights on full-time pensionable salary during their career.

4 Method and assumptions

We analyze the financial well-being of older workers in partial and full retirement in terms of the replacement rate defined as the ratio of retirement income over work income. Retirement income consists of the occupational pension income but also the state pension income if the individual is older than the legal retirement age. In the case of partial retirement, retirement income consists of the part-time work income and part-time occupational pension income but also the part-time state pension income if the individual is older than the legal retirement age. Retirement income is from pension savings and excludes any type of personal savings. In fact, in the Netherlands, many people make mortgage payments and therefore have less income available for consumption during their working years, while they finish their payments and have more income available for consumption during their retirement years. This means that personal savings might affect the amount of income available for consumption before and after retirement and hence also the replacement rate.

When calculating the replacement rate, we define work income as the wage earned in the last job before age 60. Alternatively, we could define it as the average of life-time wages earned. The two income amounts will differ from each other to the extent that the age profile of wages is upward sloping. However, work income affects the value of a replacement rate through the pension income in the numerator of the replacement rate, and through the work income in the denominator. This means that an alternative work income profile specification could have several effects on the replacement rates and it is not a priori clear which effect dominates. Throughout our analysis we use the work income from the last job when calculating a replacement rate. A main economic motivation is that retired individuals may evaluate their retirement income adequacy by comparing their pension income against what they have earned during the last years of their career instead of the average of what they have earned throughout their entire career. We approximate the wages earned during the last years of the career with the wage earned in the last job. This approximation is likely to be good for at least two reasons. First, the age-income profiles in the Netherlands are fairly flat as of age 60 (Knoef

et al., 2013). Second, job mobility is particularly low at the end of the working life and therefore wage is unlikely to show large variation during the last years of the career (Euwals et al., 2014). Therefore, the use of wage from the last job in the calculation of replacement rates may lead to replacement rate predictions that are accurate approximations of how individuals evaluate their retirement income adequacy. Besides this economic reason, it is difficult to consider the average life-time work income in the calculation of a replacement rate because in the data complete histories of wages earned is available only for a limited number of individuals.

We calculate both gross and net replacement rates. The gross replacement rate uses the gross amounts of pension and work income. To calculate the net replacement rate, we apply the income tax rules on the gross amounts of pension and work income, as described in Section 2. Even though gross (work) income remains the same, net income may change with age in the last years before full retirement, due to the change in marginal tax rates at the legal retirement age, or due to the employed person's tax credit. By taking full-time work income before age 60 as the reference, we do not incorporate these changes in the replacement rates. The age-dependent "work bonus" may also change the net work income in the last years before full retirement. This tax credit has been in operation from 2009 until 2018 with an amendment in 2013. We do not account for this tax credit in our calculations because it does not apply to all cohorts of older workers in our data, and because it is abolished and has no policy relevance.

We conduct three types of analyses. First, we analyze the actual replacement rates. We calculate the actual replacement rates using observed wages earned in the last job, occupational pension annuities received from the age individuals are retired, and the universal state pension annuity received if individuals are above the state pension age. In the data very few individuals are observed to retire full-time after the legal retirement age or to retire part-time from a full-time job at any given age (Section 3). Therefore, we calculate the actual replacement rates only among the individuals who retired full-time at the legal retirement age, and among a smaller group of individuals who retired full-time before the legal retirement age.

Given the small number of individuals observed to retire full-time after the legal retirement age, or to retire part-time at any given age, in a second analysis, we predict replacement rates in scenarios of partial and abrupt full retirement at all ages from 60 to 70. We predict the replacement rates using observed wages earned in the last job, occupational pension annuities predicted based on the observed accrued pension rights of individuals in the data, and the universal state pension annuity received if individuals retire at the state pension age, and otherwise the state pension annuities predicted based on the universal state pension annuity if individuals defer claiming state pension rights.

Occupational pension annuities in alternative retirement scenarios are predicted as follows. We start with the observed accrued pension rights of individuals who retired at the legal retirement age, but also with those of the smaller group of individuals who retired before or after the legal retirement age. Using the observed accrued pension rights, we predict pension annuities using the stylized pension rules described in Section 2 that apply to the Stichting Pensioenfonds Zorg en Welzijn, or to the Stichting Pensioenfonds ABP, the two largest pension funds in the Netherlands. Note that, unlike earlier studies of retirement income adequacy, we do not make assumptions about wage rate, wage growth, and employment history of workers to forecast their pension annuities (cf., e.g., De Bresser and Knoef, 2015; Knoef et al., 2016). We observe the accrued pension rights at the time of retirement, and use them to predict pension annuities in different retirement scenarios.

In an abrupt retirement scenario where a hypothetical individual, for example, works full-time until age 70, we predict the pension annuity at age 70 as follows. First, the pension rights accrued until age 65 and deferred at this age until age 70 increase due to the actuarial adjustment at age 70 when these rights are eventually claimed. We calculate this actuarial

adjustment by multiplying the accrued pension rights at age 65 with the actuarial factor specific to age 70, which is, for example, 1.480 in 2010 (Table 2). Second, due to deferring the claim of pension rights and working during the years from age 65 until age 70, additional pension rights are accrued during these years, which are, again, actuarially adjusted at age 70. Accrued pension rights are calculated by summing the rights accrued in each year. In a given year, accrued rights are calculated as the product of the full-time equivalent, the accrual rate, and the premium base. The full-time equivalent is equal to 1 if the individual is assumed to be working full-time. The accrual rate is, for example, 2.05 in 2010 (Table 1). The premium base is given by the difference between the gross income and the state pension offset. We consider the observed gross wage income earned in the last job as the gross income. The state pension offset is equal to €10,482 in 2010. We then multiply the pension rights accrued from 65 to 70 with the actuarial factor specific to age 70, which is 1.480. The sum of the pension rights deferred at age 65 and actuarially adjusted at age 70 and the additional pension rights accrued during the deferral years from age 65 until 70 and actuarially adjusted at age 70 determines the predicted pension annuity at age 70.

In a partial retirement scenario, where the hypothetical agent works full-time until, for example, age 65, and partially retires from age 65 to 70, we predict the pension annuity at age 70 in the same manner as in the abrupt retirement scenario, except that the full-time equivalent during the accrual of pension rights from age 65 to 70 is considered as 0.5.

The state pension annuity is given by the universal flat-rate state pension paid to all individuals as of the state pension age. State pension annuity is predicted if state pension rights are deferred at the state pension age. The prediction is done in the same manner as for the occupational pension annuity except that, according to the assumed state pension scheme that allows an employee to defer part or all of his state pension rights, suitable actuarial factors are used and it is not possible to accrue additional pension rights during the deferral period (Section 2). For example, in an abrupt retirement scenario where a hypothetical individual works full-time until age 70, we predict the pension annuity at age 70 as follows. The pension rights accrued until age 65 and deferred at this age until age 70 increase due to the actuarial adjustment at age 70 when these rights are eventually claimed. We calculate this actuarial adjustment by multiplying the accrued pension rights at age 65 with the actuarial factor specific to age 70, which is, for example, 1.343 in 2010 (Table 2).

Given the predicted replacement rates based on the actual earnings and accrued pension rights of individuals in the sample data, in a third analysis, we study the distribution of the replacement rates, and how partial retirement, compared to full retirement, affects the risk of falling below a minimum target replacement rate. In the Netherlands, social insurance schemes, including the unemployment and disability insurance schemes, pay benefits that replace 70 percent of the gross wage earned in the last job. We assume that the statutory replacement rate in social insurance schemes is also the target replacement rate in the pension domain so that pension income from the state and occupational pension schemes replace at least 70 percent of the final gross earnings. The net replacement rate, however, is larger than the gross replacement rate. We abstract from the impact of income taxation, and maintain that the minimum target replacement rate is also 70 percent in net terms. We present results based on a minimum target replacement rate of 80 percent as part of a sensitivity analysis.

5 Results

Observed replacement rates

Figure 1 presents the average of the gross replacement rates at age 65 when individuals retire full-time at given ages from 60 to 65. The figure shows that individuals who retire at age 63 or 64 accumulate the most pension rights relative to their final full-time wage compared to other individuals who retire at earlier or later ages. A potential reason is that those who retire at ages 63 or 64 accumulate more pension rights to afford retirement at these ages. This result suggests that individuals aim at achieving a certain level of retirement income that they find adequate to retire. As a result, it also suggests that when deciding on the retirement age, retirement income adequacy plays a more important role than institutional incentives or social norms which require retirement at the statutory retirement age. This finding might then explain why the effective retirement age is lower than the statutory retirement age in the Netherlands as in many other western countries.

Predicted replacement rates in scenarios of full and partial retirement

Figure 2 presents the gross and net replacement rate trajectories in scenarios of abrupt retirement at given ages from 60 to 70. For example, in the left panel of the figure, in the scenario of abrupt retirement at age 60, the gross replacement rate is 33 percent from age 60 until age 65, and 54 percent from age 65 and onwards. A replacement rate at a given age represents the average of the replacement rates predicted at that age based on the actual wages earned in the last job and the pension rights accrued by individuals who retired fully from a full-time job at ages from 54 to 65. Pension rights are accrued on full-time pensionable salary for at least 35 years by the time these individuals retire at age 65. At least 30 years of pension accrual is required for the individuals who retire at age 60.

A comparison of the gross and net replacement rates shows that the net replacement rates are higher than the gross replacement rates. This is because pension income is lower than wage income meaning that pension income is taxed at a lower tax bracket. The difference between the gross and net replacement rates is larger after age 65 than before age 65. This is because the tax rate as of age 65 is lower than that before age 65 (Section 2).

The gross replacement rate for abrupt retirement at age 65 is 77 percent. This is substantially lower than the gross replacement rate of 97 percent calculated by the OECD using the national parameters and rules applying in 2016 (OECD, 2017). The difference is mainly due to that the OECD calculates the replacement rate based on a fictitious person who earns the median income during his whole career and accrues pension rights for 45 years on full-time pensionable salary. In the sample data, however, very few people accrue pension rights for a total of 45 years on full-time pensionable salary. For example, among those observed to have worked full-time and retired the year after, the mean number of years of pension accrual on full-time pensionable salary is 26.6 years among men and 21.6 years among women. The presented replacement rates are, however, calculated based on the restriction of at least 35 years of pension accrual on full-time pensionable salary. Indeed, Knoef et al. (2016) argue that attention should be paid when evaluating the effectiveness of the Dutch pension system to replace pre-retirement earnings since career interruptions limit the amount of pension rights individuals accrue. In the next section we analyze how different numbers of years of pension accrual affect retirement income adequacy when individuals retire part-time and full-time.

Considering the gross replacement rates attained at the time of retirement, there is a large difference between those when people retire before the legal retirement age, and those when people retire at or after the legal retirement age. While the gross replacement rates range

from 33 to 52 percent when people retire before the legal retirement age, they are much larger and range from 77 to 98 percent when they retire at or after the legal retirement age. This is due to the fact that before the legal retirement age individuals do not have access to the state pension income, and occupational pension income replaces the final wage only to a limited extent, especially because occupational pension rights are actuarially penalized due to claiming earlier than the legal retirement age.

Considering the gross replacement rates attained at the age of 70, there are large differences across people who retire at different ages from 60 to 70. That is, at age 70, the gross replacement rates range from 54 to 72 percent across people who retire at ages from 60 to 64. They range from 77 to 98 percent across people who retire at ages from 65 to 70. This shows that delaying retirement increases retirement income adequacy, and the increase after age 65 is larger than that before age 65. This is due to the fact that the actuarial increase in pension rights for delaying retirement is larger at older ages. Another finding is that pension income does not fully replace the final earnings before retirement even if retirement is delayed until age 70. For example, for the individual who retires at the normal retirement age of 65, pension income replaces about 77 percent of the final earnings, and it takes five additional years of full-time work to replace about 98 percent of the final earnings. A contributing factor is that gross replacement rates are capped at 100 percent by law, leading to mean replacement rates smaller than 100 percent.

The differences across the net replacement rates are smaller compared to the differences across the gross replacement rates, especially after age 65. This is due to the progressive nature of the tax system. Those who retire later and accrue more pension rights are taxed in the higher tax brackets and have a lower replacement rate. This demonstrates the redistributive role of the progressive tax system in pension provision.

Figure 3 presents the gross and net replacement rate trajectories in scenarios of partial retirement at given ages from 60 to 65. The duration of partial retirement is considered to be always five years.

Figure 4 reproduces the net replacement rates from Figures 2 and 3. In particular, the left panel shows the net replacement rates where individuals retire full-time from their full-time job at given ages from 60 to 65, and the right panel shows the net replacement rates where individuals retire part-time from their full-time job at the same ages for a period of five years. A comparison of the replacement rates in the left and right panels of the figure provides several findings. First, considering the replacement rates attained before age 65, when individuals retire part-time, they attain replacement rates that are about 30 percentage points higher than if they retire full-time at the same ages. Considering the level of replacement rates, partial retirement allows individuals to attain at least the minimum target replacement rate of 70 percent, while full retirement at the same ages leads to replacement rates that are below 56 percent. This shows to what extent partial retirement helps workers to insure their financial well-being against the large income shock they face if they retire before the legal retirement age and have to rely on their occupational pension income.

Second, considering the replacement rates attained after age 65, retiring part-time, instead of full-time, before age 65 leads to replacement rates that are about 15 percentage points higher. Compared to the much larger gap of 30 percentage points before age 65 presented above, the smaller gap after age 65 is due to the account of the first pillar pension in the net replacement rate.

Overall, compared to full retirement, partial retirement results in a much smoother income path. For example, for the people who retire fully at age 63, the average net replacement rate changes from 50 percent at age 63 to 83 percent at age 70, while for the people who partially retire at age 63 for a period of five years, the average net replacement rate changes from 78

percent at age 63 to 96 percent at age 70. This demonstrates to which extent partial retirement helps individuals to smooth their income path over the course of the retirement years when they retire before the normal retirement age.

The risk of falling below the minimum target replacement rate

In Figures 2 and 3 we analyzed replacement rates in scenarios of partial retirement and abrupt full retirement at ages from 60 to 70. In these scenarios, a given replacement rate represented the mean of the replacement rates predicted based on the actual earnings and accrued pension rights of the individuals in the sample data. Here we study the distribution of the predicted replacement rates, and in particular analyze the fractions of individuals who fall below the minimum target replacement rate of 70 percent when they retire part-time compared to when they retire full-time. In this analysis we focus on retirement before the legal retirement age since after the legal retirement age the state pension enables workers to attain the minimum target replacement rate to a large extent as shown in the preceding subsection.

In Figure 5 we analyze the fractions of individuals with a net replacement rate below the minimum target replacement rate at the age (from 60 to 65) individuals retire full-time and part-time (any number of years). The figure shows that almost all individuals who retire full-time before the age of 65 fall below the minimum target replacement rate. As demonstrated by Figure 2, this is due to the fact that, before the legal retirement age, occupational pension income replaces the final wage to a limited extent, especially because occupational pension rights are actuarially penalized due to claiming earlier than the legal retirement age. The very large risk of falling below the minimum target replacement rate before the legal retirement age can explain why individuals often retire at the legal retirement age they are entitled to the state pension benefit (Mastrobuoni, 2009; **?**). The figure shows to what extent partial retirement helps workers to insure their financial well-being against this large risk. That is, based on the replacement rates predicted among the individuals in the sample data, partial retirement, instead of full retirement, substantially decreases the fraction of individuals who fall below the minimum target replacement rate, for example from about 95 percent to just 12 percent at age 63.

In Figure 6 we analyze the fractions of people with a net replacement rate below the minimum target replacement rate at age 70 when people retire full-time and part-time at each age from 60 to 65. We distinguish among different partial retirement scenarios where individuals spend different numbers of years in partial retirement. We analyze the risk of falling below the minimum target replacement rate after the state pension age, in particular at age 70, so that in all scenarios the state pension income is taken into account in the replacement rates. There are two main findings. First, the risk of falling below the minimum target replacement rate decreases as people retire full-time or part-time at later ages. This is because accrued pension rights are larger at later retirement ages, and because pension rights are less heavily penalized at later retirement ages. Second, partial retirement, instead of full retirement, substantially decreases the risk of falling below the minimum target replacement rate. For example, at age 63, while the risk is about 22 percent if individuals retire full-time, it is about 14 percent if individuals instead remain employed part-time for two years, and about 4 percent if they remain employed part-time for five years.

Vulnerable groups

In Figure 7 we analyze the risk of falling below the minimum target replacement rate at age 70 among the individuals who accumulated pension rights for at least 35 years (the same individuals in Figure 6) and among those who accumulated pension rights for 25 to 34 years. Among

the individuals who accumulated pension rights for fewer years, the risk of falling below the minimum target replacement rate is substantially higher at any given age individuals retire full-time or part-time. However, the risk is substantially lower among the individuals who retire part-time than among those who retire full-time, at any given age. In fact, individuals who retire part-time for a period of five years and have 25-34 years of pension accrual appear to have a very similar risk profile as the individuals who retire full-time and have at least 35 years of pension accrual.

In Figure 8 we analyze the impact of the earnings level on the risk of falling below the minimum target replacement rate. We consider two income groups with respect to the amount of wages earned in the last full-time job: €25,000-34,999 and €55,000-64,999. High-income earners appear to be much more likely to have a replacement rate that is below the minimum target level. The main reason is that for a high-income earner the state pension income is much smaller relative the wage income, leading to a smaller replacement rate.

Figure 9 shows how domestic situation affects the risk of falling below the minimum target replacement rate. Those living with a partner are much more likely to fall below the minimum target replacement rate. There are two main reasons. First, the state pension is smaller for those living with a partner. Second, the gross wage earned in the last full-time job is lower among the singles than that among those living with a partner. In the sample data, on average, while singles earned €48,440, those living with a partner earned €64,446 in the last job they worked on a full-time basis.

Figure 10 shows how the risk of falling below the minimum target replacement rate differs between men and women. Compared to women, men are roughly twice more likely to fall below the minimum target replacement rate regardless of the age they retire full-time or part-time. Larger replacement rates for women are due to that women earn lower wages and for them the state pension replaces a much larger share of the pre-retirement earnings. This result is notable because despite that we require that women, like men, accrue occupational pension rights on full-time pensionable salary for at least 30 years by the time they retire at age 60, or for more years if they retire later, their wage is low enough to lead to replacement rates roughly twice as large as those of men. In the sample data, on average, while women earned €48,860 in the last job they worked on a full-time basis, men earned €65,551. The wage differential between women and men is due to that in the health care sector men more often occupy highly paid medical professions.

Policy simulations

Using the actual earnings and accrued pension rights of the individuals in the sample data, we predicted replacement rates in alternative retirement scenarios. Using the distribution of the predicted replacement rates, we studied the fraction of individuals who fall below a minimum target replacement rate of 70 percent at age 70. In Figure 6 we showed how this fraction depends on an early retirement age, and the type of retirement (partial or full). Here we consider a higher minimum target replacement rate, and study the fraction of individuals who fall below the higher minimum target replacement rate, in comparison to the fraction of individuals who fall below the minimum target replacement rate of 70 percent. Figure 11 presents the risk of falling below the minimum target replacement rate when minimum is defined as 70 percent, and when it is defined as 80 percent. In the case of full retirement, the risk of falling below the minimum target replacement rate at age 70 increases by a large amount of about 25 percentage points when the threshold for the minimum target replacement rate is increased from 70 to 80 percent. In the case of partial retirement at given ages from 60 to 62, we obtain a similar amount of increase. The increase is smaller at later ages of partial retirement. Another notable finding

is that individuals who retire part-time for a period of five years and fall below the minimum target replacement rate of 80 percent have a similar risk profile as the individuals who retire full-time and fall below the minimum target replacement rate of 70 percent. This shows that, before the legal retirement age, individuals who retire part-time instead of full-time more often attain a retirement income that is deemed adequate from the point of view of the statutory gross replacement rate of 70 percent provided in social insurance schemes.

Throughout our analyses we assumed zero wage inflation, and therefore we did not consider indexation of occupational pension rights when making projections in hypothetical retirement scenarios. We also assumed zero price inflation. Here we retain our assumption of no wage inflation, and hence no indexation, since largest pension funds did not index pension rights during the last five to ten years due to their low funding ratios. However, we allow for price inflation that rises at an annual rate of 1 percent. That is, we deflate the paid pension rights at each year of retirement to obtain corresponding amounts in real terms. Figure 12 shows the risk of falling below the minimum target replacement rate at age 70 when paid pension rights are not corrected, and when they are corrected for price inflation. The figure shows that the risk of falling below the minimum target replacement rate is higher due to price inflation since deflated pension rights are smaller than nominal pension rights, relative to final earnings. For example, in the case of full retirement at age 60, the risk is about 10 percentage points higher when pension rights are corrected for price inflation compared to when they are not corrected. The large difference is due to that individuals who retire full-time at age 60 are exposed to 1 percent price inflation and no indexation for 10 years until retirement at age 70. The risk becomes smaller as individuals delay retirement since they accumulate more pension rights and defer their pension claims until retirement. The risk is substantially smaller in the case of partial retirement. This shows that individuals who retire part-time instead of full-time are much less prone to an income shock due to changes in the general price level over the retirement years.

In 2014 the "Generation Pact" was introduced in the collective labor agreements of a number of municipalities. In later years the scheme is expanded to cover other sectors. Generation Pact is a partial retirement scheme offering two types of financial incentives that make it more attractive than the partial retirement scheme already available from the majority of pension funds. First, it allows the employee to accrue pension rights based on the former wage instead of the part-time wage earned during partial retirement. Second, the wage rate during partial retirement is higher than that in the former job. It is assumed that the employer will finance the higher wage of the older worker by employing a younger worker who will replace the number of hours released by the older worker, but earn per hour a wage that is lower than that earned by the older worker. For example, in a widely used variant of the scheme, the employee works 80 percent of the hours he worked in his former full-time job, earns 90 percent of the wage he earned in his former full-time job, and accrues pension rights based on 100 percent of the wage he earned in his former full-time job. Alternative variants are possible, such as that the number of work hours is 60 percent of the number of hours worked in the former full-time job, the wage earned is 80 percent of the wage earned in the former full-time job, and pension rights are accrued based on 100 percent of the wage earned in the former full-time job. The employee must work, however, at least 50 percent of his former number of work hours, and can start to participate in the scheme at most 10 years before the statutory retirement age.

Here we analyze the replacement rates of workers when they participate in the Generation Pact scheme and earn wages and build pension rights on favorable terms, and when they participate in the default partial retirement scheme offered by their pension fund. Our particular aim is to show how much the final pension income is affected when employees rely on a favorable wage income from their employer when participating in the Generation Pact, compared to when they instead finance their income during partial retirement using their labor income but also

their occupational pension income when participating in the default partial retirement scheme.

During participation in both schemes, we assume that individuals work 80 percent of the hours they worked in their former full-time jobs. We consider the widely used variant of the Generation Pact where individuals are paid 90 percent of the wage they earned in their former full-time job, and accrue pension rights based on 100 percent of the wage they earned in their former full-time job. In the default partial retirement scheme, however, individuals are paid 80 percent of their former wage, claim occupational pension rights that amount to 10 percent of their former wage, and accrue pension rights based on the part-time wage they earn during partial retirement. This means that during participation in both schemes, the total income received is equal to 90 percent of the former wages earned, but this income is paid by the employer when participating in the Generation Pact scheme, while it is financed by labor income as well as by accrued pension rights when participating in the default partial retirement scheme.

Figure 13 presents the net replacement rates of the individuals when they participate in the Generation Pact and when they participate in the default partial retirement scheme. Considered are scenarios where individuals retire part-time from their full-time job at given ages from 60 to 64 until the statutory retirement age. During partial retirement, individuals attain a net replacement rate of about 96 percent when they participate in either of the two schemes. Considering the scenario of partial retirement at age 60, during full retirement from age 65, individuals attain a net replacement rate of about 85 percent if they participate in the default partial retirement scheme, while they attain a net replacement rate of about 92 percent if they participate in the Generation Pact. The difference is due to that individuals accrue pension rights on a lower wage income when they participate in the default partial retirement scheme. The difference reduces to 1 percentage point when individuals partially retire at age 64. The reduction is due to that individuals accrue more pension rights if they partially retire at later ages. This shows that, the gain in income replacement in retirement from participating in the Generation Pact is higher if employees partially retire at earlier ages.

Figure 14 shows the risk of falling below the minimum target replacement rate of 70 percent at age 70 when individuals participate in the default partial retirement scheme and when they participate in the Generation Pact. Considering the scenario of partial retirement at age 60, the risk is about 19 percent if individuals participate in the default partial retirement scheme, while it is about 8 percent if they participate in the Generation Pact. The risk becomes smaller if individuals partially retire at later ages in the default partial retirement scheme.

Section 2 described an alternative state pension scheme proposed by the government in 2008. The scheme allows deferral of state pension rights to a later retirement age fully or partially. In our analyses, we assumed that the proposed pension scheme is in operation, and in hypothetical retirement scenarios individuals who work beyond age 65 defer part or the full amount of their state pension rights until retirement to smooth their total income. Here we assume that the effective state pension scheme is in operation, and hence deferral of state pension receipt is not possible. However, we consider that individuals who delay retirement defer their occupational pension rights as the occupational pension scheme allows them. Considering the net replacement rates attained at age 70, we find small differences between when individuals delay receipt of their state pension rights and when they claim their state pension rights at the legal retirement age. For example, when individuals partially retire at age 63 and defer their state and occupational pension rights for five years until age 68, they attain a net replacement rate of about 96 percent at age 70, while when they partially retire at age 63 for five years and defer their occupational pension rights until age 68 but claim their state pension rights at the legal retirement age, they attain a net replacement rate of about 95 percent at age 70. Considering the risk of falling below the minimum target replacement rate at age 70, while the risk is 4.8 percent for the former group of individuals, it is 4.1 percent for the latter group of individuals.

6 Conclusion

Policy makers are confronted with the challenge of making the pension income adequate for older individuals and the pension system sustainable at the same time. Partial retirement can be an instrument to achieve both goals. Combining wage and pension income can fund old-age consumption, and induce individuals to extend their working lives up to the legal retirement age or beyond. We showed that, on average, older workers attain at least a minimum target replacement rate of 70 percent during partial retirement, and a higher replacement rate during full retirement, when they retire part-time and combine part-time earnings with part-time pension before the legal retirement age. The replacement rates fall much below the minimum target replacement rate when workers retire full-time at the same ages. Furthermore, considering the distribution of replacement rates across individuals, we showed that, compared to those who retire full-time, those who retire part-time have a much smaller risk of falling below the minimum target replacement rate both before and after the legal retirement age. An important implication of this result is that, when individuals retire part-time instead of full-time at a given age, they are always (much) less prone to income shocks due to, for example, zero indexation of occupational pension rights, or a smaller occupational pension income for having accumulated pension rights for fewer years.

Relevance of partial retirement for pension income adequacy before the legal retirement age is likely to increase in the coming decades. Early retirement schemes have been phased out in the last decade. This may increase the scope of partial retirement before the legal retirement age as older workers lack the incentives to retire early from generous early retirement schemes (Bloemen et al., 2016; Muns, 2018). Furthermore, the legal retirement age is being increased since 2013. Partial retirement can be expected to become prevalent among older workers, at least among those working in physically demanding occupations, who want to retire earlier than the legal retirement age (Vermeer et al., 2016; Kok et al., 2018). In fact, since 2014, an increasing number of collective labor agreements are allowing older workers to participate in the "Generation Pact" scheme and partially retire, where they earn wages and build pension rights on favorable terms. From a public finances point of view, partial retirement can in fact increase the number of years of pension contributions and tax revenues during the otherwise early retirement years as it has been shown that partial retirement can increase total labour supply if it is offered to individuals who would otherwise fully retire in an abrupt manner before the legal retirement age (Been et al., 2018).

We analyzed replacement rates in alternative retirement scenarios based on the pension rights accrued and wages earned by individuals who work in the health care sector. Limiting our analysis to a certain sector of the labor market does not necessarily undermine the representativeness of our analysis. All retirees who never lived abroad receive the full state pension, and the majority of them participate in a mandatory occupational pension scheme that is of the defined benefit type. Furthermore, the occupational pension regulation is very similar across pension funds. This means that our predictions of the replacement rates would not have been different by any substantial amount if additional data, or other data from other pension funds, were used. In fact, the mean gross and net replacement rates we predict are comparable to those predicted by Knoef et al. (2016). In particular, while we predict that the mean gross and net replacement rates are 77 and 87 percent (Figure 2), respectively, Knoef et al. predict that they are 71 percent and 84 percent (Tables 4 and 6). Analysis of Knoef et al. is based on occupational pension entitlements projected by Statistics Netherlands using individual data from pension funds who are obliged to provide Statistics Netherlands with pension entitlements records on an annual basis.

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Appendix

Details of income taxation

The income after tax and health insurance premium payments is calculated according to the rules of the Dutch Tax Office (Geppaart, 2010). First, the basis for wage tax and national insurance premiums is determined. In particular, first the gross income is determined as the sum of (where applicable) work income, occupational pension benefit, and state pension benefit, all on an annual basis, including holiday allowance, end-of-year bonus, etc.[3] From the gross income, the premiums paid to the occupational pension scheme are deducted, since these premiums are fully tax deductible.[4] This gives the basis for the employee insurance premiums. The deductions and additions to the basis for the employee insurance premiums include the "Life-cycle savings scheme" premiums and private car use.[5] This gives the basis for income-related

[3]For income tax purposes there are three types of taxable income: income from (current or past) employment and home ownership, income from a substantial interest, and income from savings and investments. We consider the former only.

[4]Other deductions and additions to the gross income include the tax deductible company savings scheme premiums, wage payments in kind, and claims for future income. In our analysis these are assumed to be zero.

[5]In our analysis these are assumed to be zero.

health insurance premiums. Finally, the income-related health insurance premium is added to the basis for income-related health insurance premiums because the employer fully compensates the employee for this premium which is therefore treated as taxable income. This gives the basis for income tax and national insurance contributions.

Given the basis for the income tax and national insurance premiums, the amount of income tax and social premiums to be paid is determined according to the progressive tax brackets. The tax rates decrease by a certain percentage points after the statutory retirement age for the first two tax brackets because old-age pension insurance contributions no longer apply after this age. The average tax rate increases with income due to the increase in marginal income tax rates over the brackets. Hence, retirees with low income have the lowest income tax as a fraction of their income.

Finally, tax credits should be accounted for to determine the eventual amount of tax to be paid. Some of the tax credits provide a flat-rate amount, while others are income related, and some of them depend on the domestic situation. The amount of a tax credit can never exceed the amount of tax to be paid (before subtracting the credit) (Belastingdienst, 2019). The tax credits considered in this study are the general tax credit, employed person's tax credit, employed person's tax credit reduction, elderly person's tax credit, and the elderly single person's tax credit. We do not consider the work bonus since it was abolished in 2018. We also do not consider the single parent's tax credit, single parent's supplementary tax credit, and the combination tax credit. These tax credits depend on whether people have children living in the household, but data on this is not available for the subjects of our study.

Given the pension premiums, taxes, tax credits, health insurance premiums and the health insurance premium compensations, the net work income and retirement income can be calculated by adding the tax credits and health insurance premium compensations and subtracting the pension premiums, taxes and health insurance premiums from gross income.

Table 1: Accrual rates and state pension offset amounts for years from 2007 to 2013

Year	Accrual rate (%)		State pension offset (€)	
	Born before 1950	Born in or after 1950	Born before 1950	Born in or after 1950
2007	1.75	2.05	11,872	9,819
2008	1.75	2.05	12,209	10,097
2009	1.75	2.05	12,466	10,309
2010	1.75	2.05	12,674	10,482
2011	1.75	1.95	12,898	10,667
2012	1.75	1.95	13,062	10,802
2013	1.75	1.95	13,227	10,940

Notes: Accrual rate may differ across pension funds. The figures are for the PFZW. Accrual rates and state pension offset amounts are for the old-age pension scheme. State pension offset is also referred to as the "franchise". The accrual rate and state pension offset for year 2007 are obtained from Stichting Pensioenfonds Zorg en Welzijn (2007). The figures of later years are obtained from the "Statuten en reglementen" of later years.

Table 2: Actuarial factors for earlier and later retirement than at age 65 for years from 2007 to 2013

	Retirement age	Actuarial factor						
		2007	2008	2009	2010	2011	2012	2013
State pension scheme	66	1.055	1.055	1.054	1.054	1.053	1.053	1.053
	67	1.117	1.116	1.114	1.114	1.112	1.113	1.112
	68	1.186	1.184	1.182	1.181	1.178	1.179	1.177
	69	1.264	1.262	1.258	1.257	1.253	1.253	1.251
	70	1.354	1.350	1.345	1.343	1.337	1.339	1.335
Occupational pension scheme	60	0.719	0.719	0.719	0.719	0.747	0.749	0.752
	61	0.765	0.765	0.765	0.765	0.789	0.792	0.794
	62	0.815	0.815	0.815	0.815	0.835	0.838	0.839
	63	0.871	0.871	0.871	0.871	0.885	0.887	0.889
	64	0.932	0.932	0.932	0.932	0.940	0.941	0.942
	65	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	66	1.075	1.075	1.075	1.075	1.066	1.064	1.063
	67	1.159	1.159	1.159	1.159	1.138	1.134	1.132
	68	1.254	1.254	1.254	1.254	1.218	1.211	1.208
	69	1.360	1.360	1.360	1.360	1.306	1.296	1.292
	70	1.480	1.480	1.480	1.480	1.403	1.390	1.384

Notes: The actuarial factors of the occupational old-age pension scheme for year 2007 are obtained from Stichting Pensioenfonds Zorg en Welzijn (2007). The figures of later years are obtained from the "Statuten en reglementen" of later years. The actuarial factors of the state pension scheme are authors' calculation according to Ministerie van Sociale Zaken en Werkgelegenheid (2008) and year-specific average life expectancies for men and women available from Statistics Netherlands.

Table 3: Background and labor market characteristics

Characteristic	Attribute	%
Age	55–60	21.92
	61–65	77.92
Gender	Male	64.70
Marital status	Married or living with partner	75.30
Annual gross income	$<$ 35,000	8.05
	35,000–55,000	46.34
	$\geq$ 55,000	45.16
Number of years of pension accrual	25–34	46.07
	$\geq$ 35	53.93

Notes: The figures are based on 3,313 individuals. Annual gross income is the average wage earned in the last job in the sample and measured in euros. Totals may not add due to rounding error.

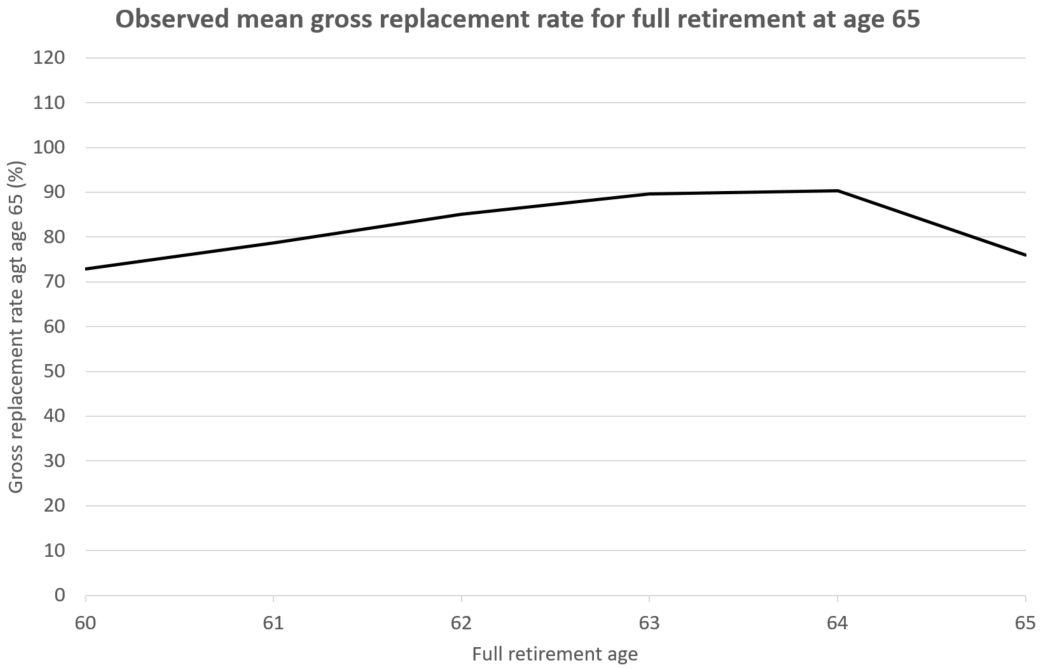

Figure 1: Observed mean gross replacement rate at age 65 when individuals retire fully from a full-time job at given ages from 60 to 65. Replacement rates are based on wages earned in the last job and on pension rights accrued on full-time pensionable salary for at least 35 years by the time individuals retire at age 65. At least 30 years of pension accrual is required for workers who retire at age 60. The mean replacement rates at given ages from 60 to 65 are calculated based on data for 2,711 individuals.

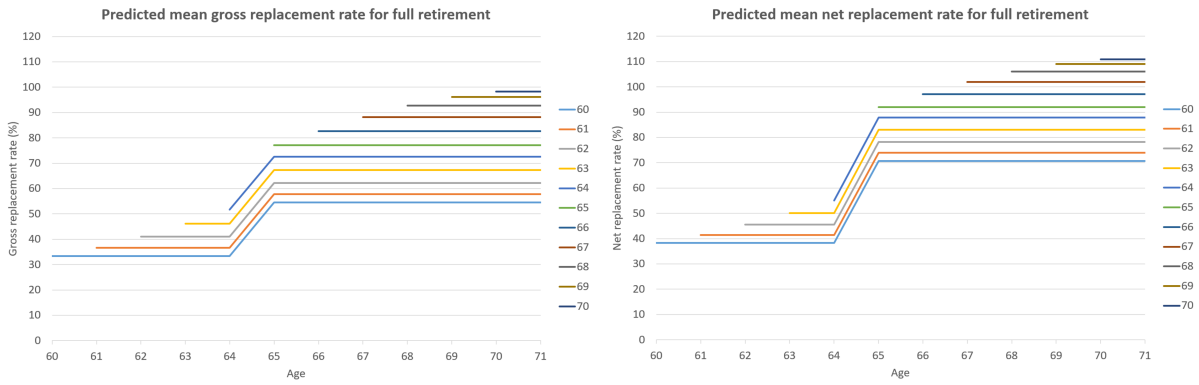

Figure 2: Predicted mean gross (left panel) and net (right panel) replacement rates in retirement scenarios where individuals retire fully at given ages from 60 to 70. Replacement rates are based on actual wages earned in the last job and on pension rights accrued on full-time pensionable salary for at least 35 years by the time individuals retire at age 65. At least 30 years of pension accrual is required for workers who retire at age 60. A mean replacement rate at a given age is predicted using data for 3,313 individuals who retired fully from a full-time job at given ages from 54 to 65.

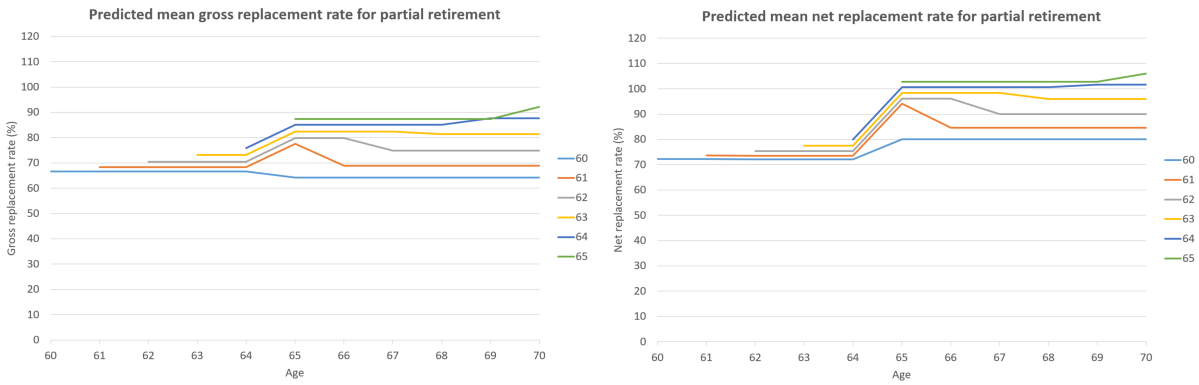

Figure 3: Predicted mean gross (left panel) and net (right panel) replacement rates in retirement scenarios where individuals retire part-time from their full-time job for a period of five years at given ages from 60 to 65. During partial retirement individuals work 50 percent of the hours they work in their full-time job, and claim 50 percent of their accrued occupational and state pension rights. Replacement rates are based on actual wages earned in the last job and on pension rights accrued on full-time pensionable salary for at least 35 years by the time individuals retire at age 65. At least 30 years of pension accrual is required for workers who retire at age 60. A mean replacement rate at a given age is predicted using data for 3,313 individuals who retired fully from a full-time job at given ages from 54 to 65.

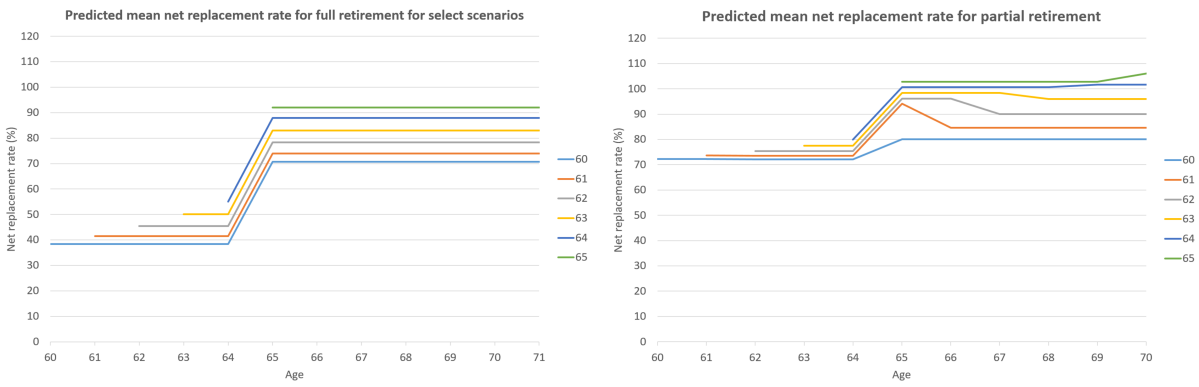

Figure 4: Income smoothing with partial retirement. Predicted mean net replacement rates in retirement scenarios where individuals retire from their full-time job fully (left panel reproducing the right panel of Figure 2 for select retirement scenarios) and partially (right panel reproducing the right panel of Figure 3) at given ages from 60 to 65.

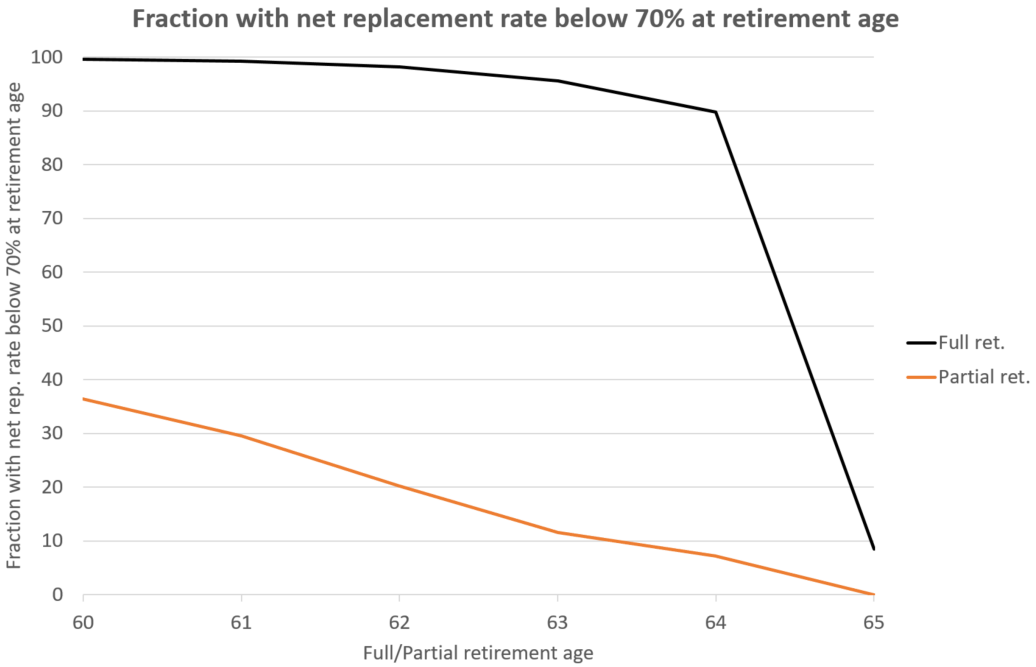

Figure 5: Fractions of individuals with a net replacement rate below the minimum target replacement rate at the age (from 60 to 65) individuals retire full-time and part-time (any number of years). Replacement rates are based on actual wages earned in the last job and on pension rights accrued on full-time pensionable salary for at least 35 years by the time individuals retire at age 65. At least 30 years of pension accrual is required for workers who retire at age 60. Replacement rates at a given age are predicted using data for 3,313 individuals who retired fully from a full-time job at given ages from 54 to 65.

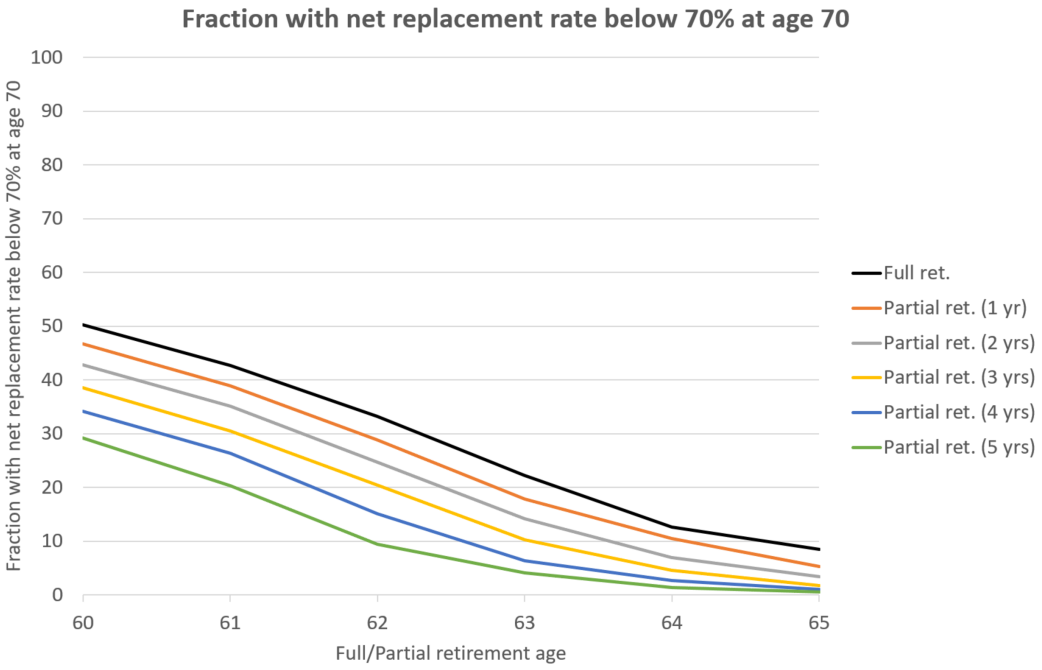

Figure 6: Fraction of individuals with a net replacement rate below the minimum target replacement rate at age 70 when individuals retire full-time and part-time –with different numbers of years spent in part-time work– at given ages from 60 to 65. Replacement rates are based on actual wages earned in the last job and on pension rights accrued on full-time pensionable salary for at least 35 years by the time individuals retire at age 65. At least 30 years of pension accrual is required for workers who retire at age 60. Replacement rates at a given age are predicted using data for 3,313 individuals who retired fully from a full-time job at given ages from 54 to 65.

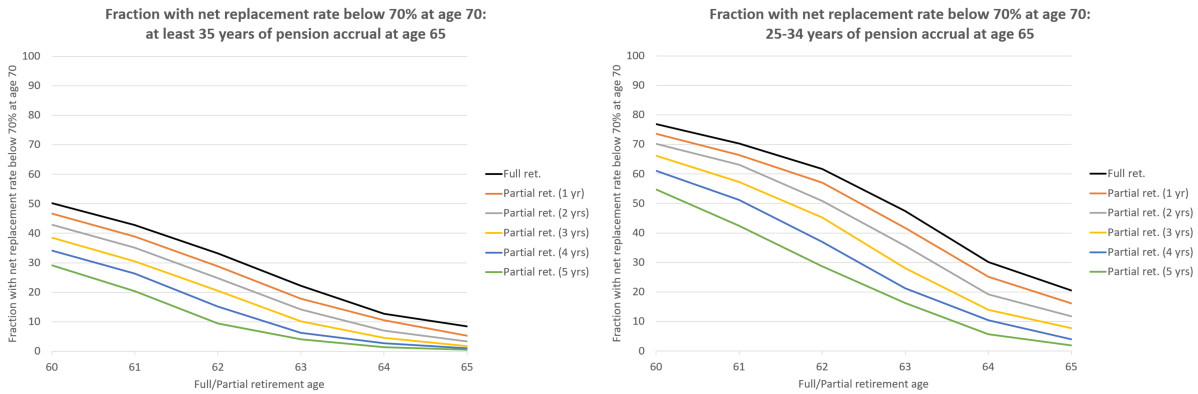

Figure 7: Fraction of individuals with a net replacement rate below the minimum target replacement rate at age 70 when individuals retire full-time and part-time –with different numbers of years spent in part-time work– at given ages from 60 to 65: for individuals who accrue pension rights for at least 35 years (left panel reproducing Figure 6) and for individuals who accrue pension rights for 25 to 34 years (right panel) by age 65. At least 30 years of pension accrual is required for workers who retire at age 60. Replacement rates are based on actual wages earned in the last job and on pension rights accrued on full-time pensionable salary for the studied cases of number of years of pension accrual. For individuals with pension accrual for at least 35 years, replacement rates at a given age are predicted using data for 3,313 individuals who retired fully from a full-time job at given ages from 54 to 65. For individuals with pension accrual for 25 to 34 years, replacement rates at a given age are predicted using data for 1,716 individuals who retired fully from a full-time job at ages from 54 to 64.

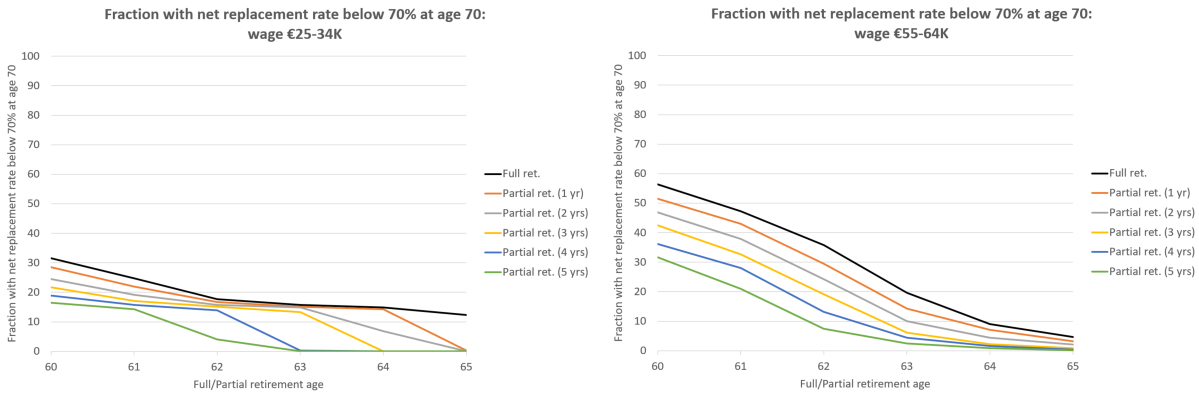

Figure 8: Fractions of individuals with a net replacement rate below the minimum target replacement rate at age 70 when individuals retire full-time and part-time –with different numbers of years spent in part-time work– at given ages from 60 to 65: for individuals with earnings €25,000–34,999 (left panel) and for individuals with earnings €55,000–64,999 (right panel). Earnings represent the wage income in the last full-time job before (partial) retirement. Replacement rates are based on actual wages earned in the last job and on pension rights accrued on full-time pensionable salary for at least 35 years by the time individuals retire at age 65. At least 30 years of pension accrual is required for workers who retire at age 60. For low income earners, replacement rates at a given age are predicted using data for 323 individuals who retired fully from a full-time job at ages from 54 to 64. For high-income earners, replacement rates at a given age is predicted using data for 539 individuals who retired fully from a full-time job at ages from 54 to 64.

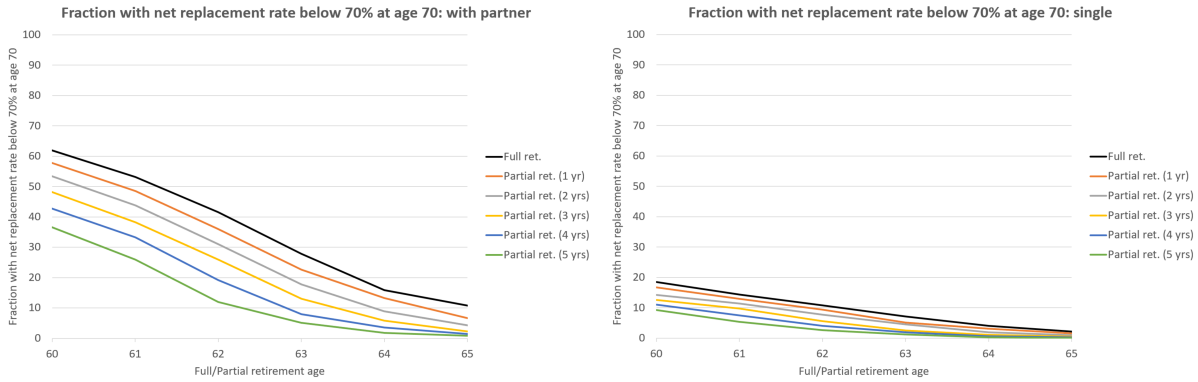

Figure 9: Fraction of individuals with a net replacement rate below the minimum target replacement rate at age 70 when individuals retire full-time and part-time –with different numbers of years spent in part-time work– at given ages from 60 to 65: for individuals with a partner (left panel) and for singles (right panel). Replacement rates are based on actual wages earned in the last job and on pension rights accrued on full-time pensionable salary for at least 35 years by the time individuals retire at age 65. At least 30 years of pension accrual is required for workers who retire at age 60. For individuals with a partner, replacement rates at a given age are predicted using data for 2,422 individuals who retired fully from a full-time job at ages from 54 to 64. For singles, replacement rates at a given age is predicted using data for 891 individuals who retired fully from a full-time job at ages from 54 to 65.

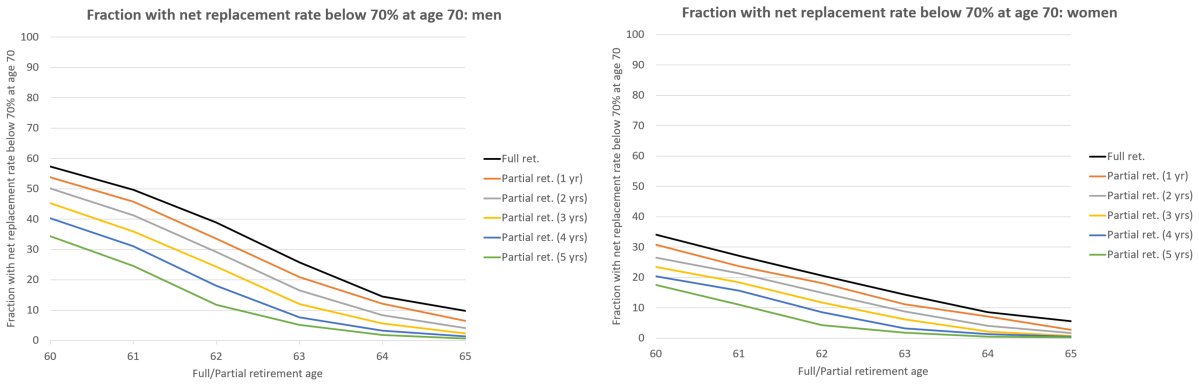

Figure 10: Fractions of individuals with a net replacement rate below the minimum target replacement rate at age 70 when individuals retire full-time and part-time –with different numbers of years spent in part-time work– at given ages from 60 to 65: for men (left panel) and women (right panel). Replacement rates are based on actual wages earned in the last job and on pension rights accrued on full-time pensionable salary for at least 35 years by the time individuals retire at age 65. At least 30 years of pension accrual is required for workers who retire at age 60. For men, replacement rates are predicted using data for 2,293 individuals who retired fully from a full-time job at ages from 54 to 65. For women, replacement rates are predicted using data for 1,020 individuals who retired fully from a full-time job at ages from 54 to 64.

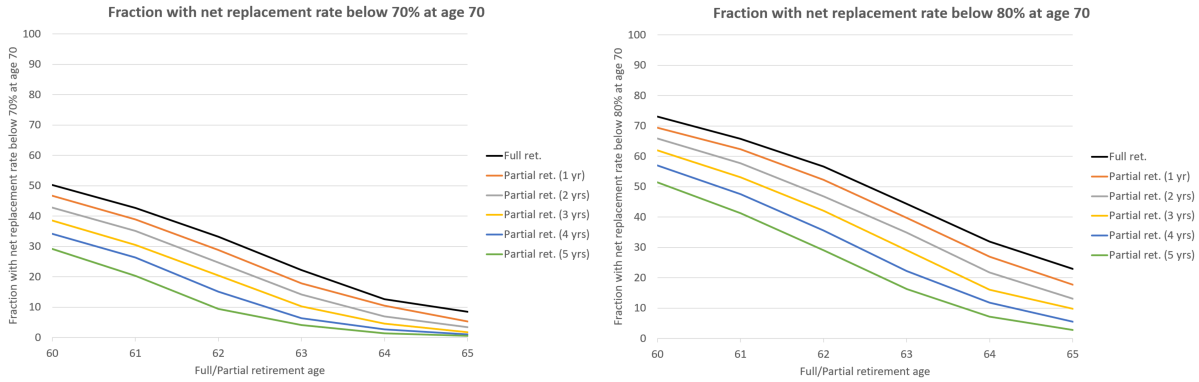

Figure 11: Fractions of individuals with a net replacement rate below 70 percent (left panel reproducing Figure 6) and 80 percent (right panel) at age 70 when individuals retire full-time and part-time –with different numbers of years spent in part-time work– at given ages from 60 to 65. Replacement rates are based on actual wages earned in the last job and on pension rights accrued on full-time pensionable salary for at least 35 years by the time individuals retire at age 65. At least 30 years of pension accrual is required for workers who retire at age 60.

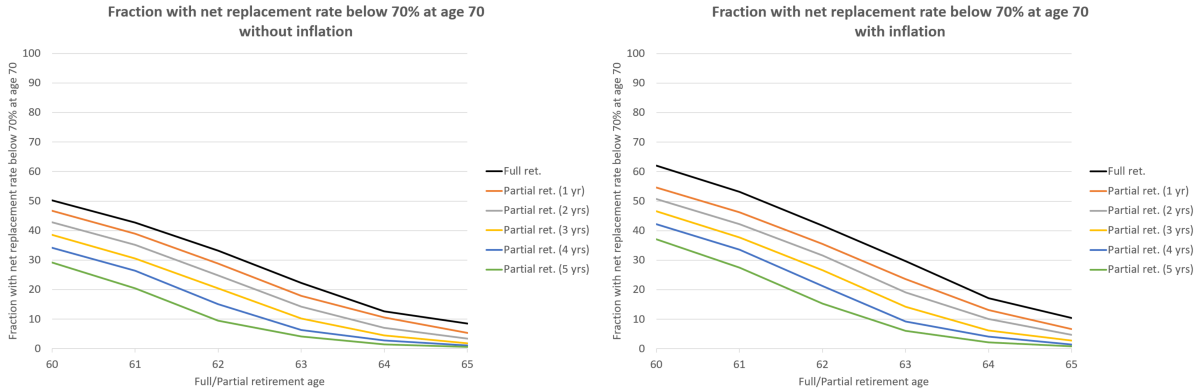

Figure 12: Fractions of individuals with a net replacement rate below the minimum target replacement rate at age 70 when individuals retire full-time and part-time –with different numbers of years spent in part-time work– at given ages from 60 to 65: when paid pension rights are not corrected (left panel reproducing Figure 6) and when they are corrected (right panel) for 1 percent annual price inflation. Replacement rates are based on actual wages earned in the last job and on pension rights accrued on full-time pensionable salary for at least 35 years by the time individuals retire at age 65. At least 30 years of pension accrual is required for workers who retire at age 60.

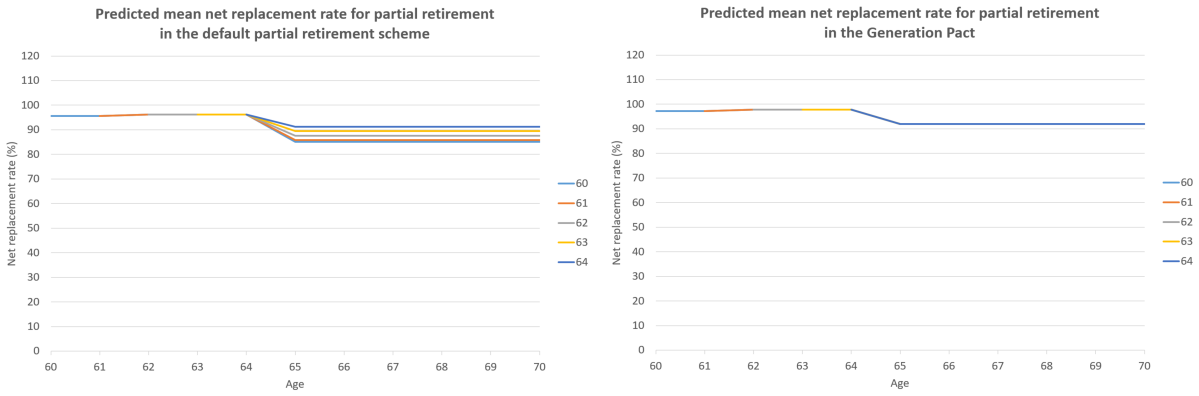

Figure 13: Predicted mean net replacement rates when individuals participate in the default partial retirement scheme (left panel) and when they participate in the Generation Pact scheme (right panel). Presented are partial retirement scenarios where individuals retire part-time from their full-time job at given ages from 60 to 64 until the statutory retirement age. When participating in the default partial retirement scheme, individuals work 80 percent of the hours they work in their full-time job, earn 80 percent of their former full-time wage, claim occupational pension rights that amount to 10 percent of their former full-time wage, and accrue occupational pension rights based on their part-time wage. When participating in the Generation Pact scheme, individuals work 80 percent of the hours they work in their full-time job, earn 90 percent of their former full-time wage, do not claim occupational pension rights, and accrue occupational pension rights based on their former full-time wage. Replacement rates are based on actual wages earned in the last job and on pension rights accrued on full-time pensionable salary for at least 35 years by the time individuals retire at age 65. At least 30 years of pension accrual is required for workers who retire at age 60.

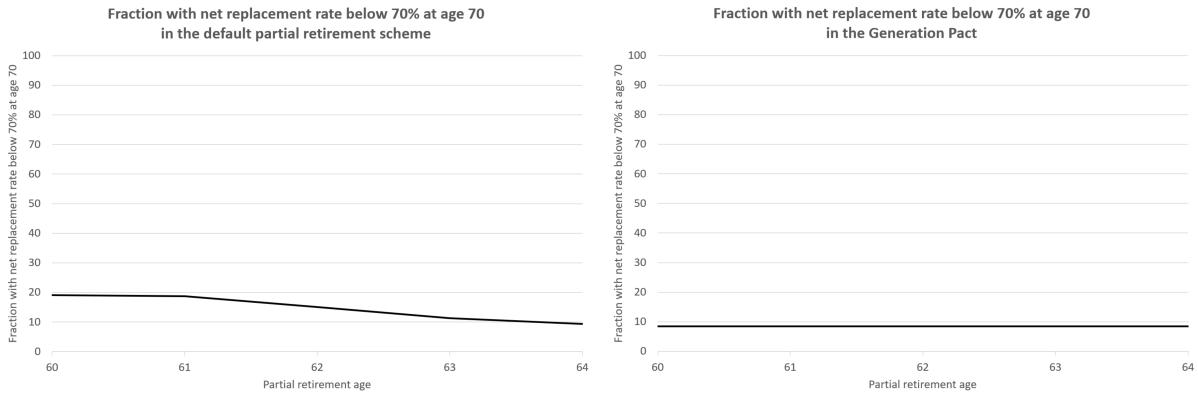

Figure 14: Fractions of individuals with a net replacement rate below 70 percent when individuals participate in the default partial retirement scheme (left panel) and when they participate in the Generation Pact scheme (right panel) at age 70 when individuals retire part-time at given ages from 60 to 64 until the statutory retirement age. Replacement rates are based on actual wages earned in the last job and on pension rights accrued on full-time pensionable salary for at least 35 years by the time individuals retire at age 65. At least 30 years of pension accrual is required for workers who retire at age 60.